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A PRELIMINARY GENERAL SURVEY OF THE MACROFAUNA OF MIRROR LAKE ON THE OHIO STATE UNIVERSITY CAMPUS.*†

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CONTENTS.

PART I.

INTRODUCTION.

The present work was undertaken with the purpose of making as extensive a survey as possible, in the limited available time, of the fauna (exclusive of the microscopic part) of a pond on the Ohio State University campus, known as Mirror Lake. Though much general collecting has been done in this pond and an extensive study of the aquatic Hemiptera made

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by Mr. C. J. Drake, in his study of that group in Ohio, no systematic survey of its fauna has been attempted, except for the Protozoa, which have been worked out recently by Miss Mabel E. Stehle, (1920).

Collections were made between March 1 and October 18, 1919, at regular intervals of two weeks and with other occasional special collections. Realizing that an entire year's careful collecting, or more, would be necessary to get adequate data for an ecological study, the writer does not consider the work an ecological, but primarily a faunal survey, with merely a few ecological notes.

For purposes of systematic collecting, definite stations were established, all selected with a few of furnishing examples of all types of habitat that seemed possible or worth while to differentiate. Stations are described below (pp. 141–144), indicated on the map (Plate I), and referred to by number in the body of the paper and in the table.

Collecting was done with a large, fine-meshed, long-handled dipnet, occasionally assisted by a smaller fine sieve strainer. In taking material at any station, water was strained through, the mass cursorily examined for all larger forms, and a good part of the mass of mud, algæ, duckweed, or whatever the material harboring the small forms, taken and put into a glass pint or quart jar labeled for the particular station. Water was dipped into the jar to fill it and thus some plankton forms probably secured which would not have been retained in the net. At successive collections the same area in each station was worked.

In the laboratory each jar was worked over by making many successive dilutions of parts of the entire haul, in a large, shallow glass dish, during which process, all animals were secured with forceps or pipette, and put into large vials of 70% alcohol, labeled according to station and date. This was done at once to prevent injury to specimens in close confinement in the jars. Later each vial was examined, the various kinds of animals separated and put into smaller vials of alcohol for permanent preservation. Separation could of course, not be done to species with any certainty whatever. The idea was to separate enough to approximate that ideal of having specimens, when identified by specialists, in individual vials unmistakably named to species.

This survey was not a quantitative one. But usually all animals of a kind were collected as far as practicable. Numbers of individuals are noted for all species listed in the table. Actual numbers alone may not signify much. If there are 10 crayfishes and 10 midge larvæ in a collection from one station, the real interpretation of these equal numbers would be that the crayfishes were abundant and the midge larvæ rather scarce. Relative abundance of these and all forms in balanced natural situations should be known and also environmental conditions in the body of water in question. Consequently in the body of the paper, use is made when possible, of the terms rare, few, many, common, abundant and sometimes other qualifying words. There always exists the difficulty of varying interpretation of these words, but this objection is outweighed by the value of the terms used in a way which carries some proper comparative significance for the various animal kinds and groups.

Groups of animals not covered in the work of this survey are mentioned here and not further referred to: Protozoa, (Stehle '20), Rotifera, Gastrotricha, Nematoda.

Compound microscope and binocular could not be used in the rather hurried work of separation and preservation, though they were later used in such identification of groups as the writer could do. Entomostraca could be detected and transferred without the lens. They are included in the survey, but the list is necessarily very incomplete, as no tow net was used and no real plankton survey made. Only those taken in the collecting above described were available. Ostracoda were omitted, for none were seen except some in jars containing material from Mirror Lake that had been in the laboratory for some time, and which hence undoubtedly represented a development under certain favorable conditions not exactly duplicated in the pond at the time.

Among Vertebrata comparatively little collecting was done. Fishes were obtained in two seinings, Sept. 27 and Oct. 4, 1919. Some vertebrate records were merely based on notes of specimens seen or on positive evidence of their presence. Amphibia were collected in the spring of 1920.

Among Invertebrata, several small groups, of which specimens were expected, were not at all represented in the collections, namely Bryozoa, and among Insecta, the Gyrinidæ.

Insecta, the largest single group, receive more emphasis than any other group.

ACKNOWLEDGMENTS.

In a survey involving necessarily so large a part of the animal kingdom, the writer had to have the assistance of a number of zoologists to make determinations in groups in which they are specialists. The writer is glad to be able to credit identifications to so many eminent specialists. To those who kindly did this work and to all who helped in any way, the writer wishes to express his great appreciation and thanks.

Among insects various groups were identified as follows: Prof. J. W. Folsom, Collembola; Dr. C. H. Kennedy, Odonata, and mayfly nymphs; Dr. J. W. Malloch, Chironomidæ, larvæ and pupæ; Dr. H. G. Dyar, through the kind suggestion of Dr. L. O. Howard, mosquito larvæ and pupæ; Prof. J. S. Hine, some adult and larval Diptera of other families; Dr. Edna Mosher, Coleoptera larvæ; Dr. H. B. Hungerford, Corixidæ; Prof. Herbert Osborn, several Hemiptera and Thysanoptera; Mr. T. L. Guyton, aphids; Dr. C. W. Leng and Dr. H. C. Fall, several Coleoptera; and Mr. C. J. Drake, a water strider.

Among other groups identifications were made as follows: Prof. Frank Smith, Oligochæta; Prof. J. P. Moore, Hirudinea; Dr. V. Sterki, Mollusca; Dr. Bryant Walker, fresh-water mussels; Mr. Chancey Juday, Cladocera; Dr. C. Dwight Marsh, Copepoda; Miss A. L. Weckel, Amphipoda; Prof. Wm. M. Barrows, spiders; Miss Caroline Stringer, a few Turbellaria; Mr. E. L. Wickliff, the fishes; and Prof. E. N. Transeau, the plants.

I am also indebted to Prof. R. C. Osburn for assistance in determining the crayfishes, and help and suggestions relative to fishes; Prof. Wm. S. Marshall for assistance, while studying and comparing beetles with his collection; Mr. T. E. B. Pope, for permission to examine beetles in collections at the Milwaukee Public Museum; Mr. P. R. Lowry, for examination of his collection of aquatic Hemiptera; Prof. Herbert Osborn, for suggestions and literature on Hemiptera; Mr. C. J. Drake for data and suggestions on aquatic Hemiptera; Prof. F. H. Krecker, for suggestions on ecological matters; Prof. Wm. M. Barrows, for suggestions on the same matters and photographing of the map of Mirror Lake; Mr. E. A. Hartley for inking the drawing of the lake; Mr. C. W. McCracken for the loan of the campus map from which this drawing was made; and Prof. R. C. Osburn for various other helpful suggestions.

PART II.

MIRROR LAKE: DESCRIPTION AND HISTORY.

This part of the original thesis form is omitted here, as the account in Miss Stehle's paper ('20), suffices. Points that should be emphasized, however, are: the artificial origin (1872) of the pond, the extensive alterations in 1895, really a second starting point for the fauna and flora, the subsequent development of these, and further changes made during and subsequent to this survey.

On April 16, 1919, after only two collections had been made, a change was wrought in the smaller of the two ponds which constitute Mirror Lake. The narrow neck of land between the two ponds was cut through which lowered the water level in the small pond about ten inches, and left organisms stranded high and dry on the muddy shore. This was to be part of an extensive "cleaning" out and general change in the pond which fortunately did not come to pass while this work was being done.*

PART III.

DESCRIPTION OF STATIONS.

Stations are not discussed in the numerical order in which they were established, but in a natural arrangement which brings together those nearest in position and environmental conditions. The same order is used in the table.

STATION 1. This was a shallow station located off the northeast shore of the small pond. It was a uniform area, a few square yards in extent, not with a soft, muddy, oozy bottom as most of the pond had, but with a partly gravelly, partly muddy bottom, sloping gradually down from the shore-line and only several inches deep on the average.

The lowering of the water level (April 16) exposed a very large part of the station, and left snails, leeches, etc., stranded on the new muddy shore.

* In the summer of 1920, after this study was terminated, the entire plan of altering Mirror Lake was carried out. It was drained, and then refilled after the small pond was completely obliterated, and the same done with the attractive island, the largest curves in the shoreline, and the northwest arm and rustic bridge of the large pond. The entire shoreline (it should be added) was lined with a wall of cobblestones!

STATION 11. This was established to replace number 1, which it slightly overlapped along the shoreline. Since most of number 1 was shore, this was out farther, with bottom more muddy and of more pronounced slope.

STATION 17. In a slight depression in the flat shore area (former station 1) an accumulation of water late in summer necessitated this new station. The bottom of this little pool was even, sandy and gravelly, and its depth three or four inches. The surface was free from duckweed, even though so close to the duckweed covered pond.

STATION 13. This was a spring on the north-east shore of the small pond, enclosed by a cylindrical brick wall, and the top partly covered by a board. It was close to three feet deep, and the water level as high as in the pond, which came practically up to the rim of the spring. After the lowering of the water level, there were several feet between the new pond edge and the spring, in which the water level was lowered almost as much as in the pond. A little water trickled down from it to the pond.

STATION 2. This was located in the northwest corner of the small pond. Its sides were both shores of the small indentation that was nearest the large pond. The shoreline was relatively steep and the water deeper than along the northeast and east shores of this pond.

STATION 12. The same change referred to above altered number 2 in several ways. The channel dug to connect the two ponds changed the former, little, secluded, duckweed covered bay to an open area, narrowed by the lowering of the water level and having a slightly perceptible current through it at times, towards the large pond. But frequent winds, blowing eastward over the large pond, moved leaves and debris up to this channel opening and practically prevented migration of duckweed from the small pond.

STATION 3. This was located off the southwest shore of the small pond. The shore was less steep and solid than other shores except the entire south-east end. The bottom sloped down rapidly and was soft and muddy.

The narrow southeast end of the small pond was low and marshy in its shoreline, the water very shallow and the bottom very mucky and muddy. It was almost choked with fallen

leaves, which, together with constant shade of nearby overhanging trees, seemed to make conditions most unfavorable for animal life. No station was established there.

STATION 4. This was located along the north shore of the large pond where the spring had its outlet. At the point of outlet, the water was only an inch deep and the bottom was gravelly. Throughout the area considered as this station, having a yard radius out from this central point, it was quite shallow, but sloped down at its outer edge to relatively deeper water. In this area the bottom was of uniformly fine gravel, a secondary accumulation. In the deeper water beyond, mud covered the bottom completely. On the shoreline for a short distance along here and beyond this station, is a line of large boulders.

STATION 14. This station, a few feet east of number 4, lacked the deposit of fine gravel along shore, and hence the water was deeper, averaging more than a foot directly off the line of shore boulders. Some projecting roots of an adjacent alder tree, with some accumulation of leaves there, made this a better habitat than at other similar places in the immediate vicinity.

STATION 15. This, located on the north shore of the larger pond about 30 feet west of station 4, was a situation similar to most of the north shore (see description for 7) but here was found overhanging grass, (even some growing in the water), and some accumulation of debris, which offered a slight retreat for a few forms not found elsewhere along this shore.

STATION 5. This station was on the south shore of the larger pond in the deep indentation which extends southward, opposite to station 4. The bank was fairly firm and about a half foot above the water's surface. The bottom here was very soft and muddy. The water throughout this bay was somewhat stagnant as it was not moved by the winds which disturbed the main east-west stretch of this pond.

STATION 6. This station also lay along the south shore, but on the end of the projecting peninsula between the bay just referred to and the main part of the large pond. Here the water was clear and relatively deep. There was some undercutting in the clay bank, projecting roots and some overhanging grass.

STATION 7. This station located on the north shore of the large pond was about sixty feet east of the east approach to

the rustic bridge. Here and along most of the north shore, the shallow shoreward waters were filled with large irregular stones, some projecting a little. The shore itself was a grassy bank a foot above the pond surface. The area of submerged stones along the shore extended out from 3 to 6 feet beyond which the water was deeper and the bottom muddy.

STATION 16. This station was located about 30 feet west of 7, or half way between it and the bridge, at the point where this shore projected out farthest. It was established solely because of the discovery of fresh-water sponge on a stone at this place.

STATION 8. This station was located on the south shore of the large pond just opposite the west end of the island. The water was fairly deep even close to shore, and the latter a grassy bank rising steeply to form a hill. Some large, submerged stones made a rocky border similar but narrower than that on the opposite shore.

STATION 9. This station was located at the northwest end of the lake just west of the small island over which passed the rustic bridge, just south of which it was. The water was very shallow, the bottom muddy and with some sand and debris accumulated there. But the layer of mud here and north of the bridge, throughout the northwest arm of the lake, (which was also shallow) was not very deep. But beyond the end of the little island, the bottom had a declivity and beyond that, as elsewhere in the large pond proper there was a deep bottom layer of dark brown or black mud. Only a part of the shallowest part was taken at this station. There algæ and some grasses grew.

STATION 10. This station was located at the southwest end of the large pond, directly around the iron pipe that was the outlet of the pond. The water was shallow, the bank and bottom of clay with a few stones submerged near shore.

PART IV.

ECOLOGY OF MIRROR LAKE.

A. The Flora of Mirror Lake.

It is only as an environmental factor that plants are considered in this survey. As with the fauna, the microscopic flora was not collected or observed.

The large pond was practically free of larger algæ as well as of higher plants, except for some favorable littoral situations.

Covering all of the upper surfaces of submerged rocks (as noted along most of the north shore) were good growths of filamentous algæ, including *Spirogyra* of several species, and *Cladophora fontanemus*, (rocks at station 4), *Spirogyra fluviatilis*, and *Oedogonium*, (rocks at station 7). *Cladophora* and *Oedogonium* were found on rocks at station 6. In the shallow waters of station 9, both on small stones at bottom and forming masses drifted in towards shallowest part were various species of *Spirogyra*. Directly north of the wooden bridge were *Mougeotia sphærocarpus* and *Spirogyra* of various species including *S. cateniformis*.

In the small pond a great development of plants took place each summer. Extensive growths of *Spirogyra*, *Cladophora*, *Vaucheria*, and *Oscillatoria limosa*, were found in this water. A complete list is not available as material for determination was collected only once, rather late in summer.

The duckweed, *Lemna minor*, beginning in small isolated groups of leaflets in spring, multiplied rapidly and by late summer formed a dense mass like a green carpet covering the water. The duckweed seemed to obliterate the algæ to a marked extent. Only along station 3 was there an area free from it. There were practically no other higher aquatic plants present.

Along the shore of the small pond grasses grew luxuriantly, and by fall these encroached upon the water. The chief grasses were *Dactylis glomeratus* (orchard grass), and *Leersia oryzoides* (saw grass or rice cut grass). Small patches of these were found in very shallow water just off shore, in the southern end of the small pond, at station 12, and likewise north of station 9 and of the rustic bridge in the large pond. Bur marigold, *Bidens connata* mingled with grasses along shore especially where much moisture prevailed.

B. Ecology of the Pond as a Whole.

Mirror lake, so artificial in origin and history could not well be compared directly with natural ponds or lakes. The larger pond was hopelessly artificial for the most part (and is more so now) lacking in many environmental factors that would make favorable habitats for many types of animals. The scarcity of animal forms found there amply illustrates that. The smaller pond soon outgrew its artificial aspect. The shoreline was less artificially maintained and a good development of plant life of some kinds allowed.

The formations or habitats of typical ponds Shelford ('13), enumerates as: (1) pelagic formation (better called limnetic), (2) pioneer formation, (terrigenous bottom), (3) submerged association, and (4) association of emergent vegetation.

Number 1 was present in Mirror Lake, though little represented in the small pond. As terrigenous bottom means a bare bottom, which eventually gives way to rooted vegetation, number 2 was, strictly speaking, not present. Except in the shoreward areas the bottom was soft, dark mud, with humus added to it. Number three was developed in the small pond (comprising algæ only) but practically absent in the large. Unless one consider the slightly submerged shore grasses in parts, number four was also absent.

From the standpoint of the development of a typical pond fauna the greatest deficiency was this of the emergent vegetation, which implies shoreward areas of cat tails, rushes, arrow heads, etc., and water lilies on the open water side. Ponds richest in life have a good development of such association together with a submerged association.

The large pond (with the exception of station 9 and vicinity) lacks characteristic floral and faunal features of ponds which, by Shelford's ('13) definition "are usually very largely captured by vegetation which is very much like that in the bays of lakes." Neither is it a lake. It is just an artificial body of water, called pond rather than lake, because of its small size, which, cannot be made to conform closely to anything in nature.

C. Ecological Habitats and Grouping of Stations Into Habitats.

Division into ecological habitats is especially difficult where the body of water is so generally of a uniform nature as is the larger part of Mirror Lake.

Needham and Lloyd's ('16) classification of habitats of ponds, satisfactory and sufficient at the same time for ecological habitats and societies of animals is: (1) Littoral, or shoreward area, with its divisions (a) Lenitic or stillwater societies, and (b) Lotic or rapid water societies; and (2) Limnetic, or open water area, with its divisions (a) Plankton and (b) Necton, the latter referring to the group of large free swimming animals. Naturally no lotic area or conditions were present in the pond.

The limnetic region in the large pond was extensive. A true pond fauna, with insects, etc., as an important part would be absent in a limnetic region. The necton, consisting here entirely of fishes, was important, especially since the fishes were rather too abundant and effective in reducing numbers among other free swimming organisms. The plankton, which would be very important, was not surveyed, except for such organisms as ranged in the littoral zone. In the small pond there was no true limnetic area at least not in its true sense, except when the vegetation and especially the duckweed covering was not developed early in the season.

The littoral region, of prime importance in a typical pond, was very much reduced in width in the large pond. While all the stations here were in the littoral zone, as far as position is concerned, results showed that stations 10, 8, 4, and to a smaller extent, 16, 7, 6, and 5, (in about that order) were more or less deprived of a fauna, except for a few surface forms (such as water striders) which might, occasionally or frequently, be there, and some possible bottom forms that may have been missed. The shoreline in part at least, was not unsatisfactory, and there might have been more evidence of the "sheltering influence of shore," if there had been somewhat more vegetation, and fewer fishes, which invade even to the shoreline. The broad row of large, submerged stones along the north shore offered good environment for lithophilous forms.

In the smaller pond also the littoral region, included all collecting stations, and included, when duckweed covered the surface, practically the whole pond; or at any rate the pond was more nearly of the littoral type than anything else. The lack of emergent, rooted vegetation would not be typically littoral. The bottom mud was deep here, but no deeper than in the large pond, and it had a larger deposit of humus.

PART V.

GENERAL SYSTEMATIC SURVEY OF THE MACROFAUNA WITH NOTES ON THE VARIOUS SPECIES.*

Phylum PORIFERA.

Spongilla fragilis Leidy. Fresh-water sponge was found on only one of the large, submerged stones, on the north shore of the large pond. The flat, gray, incrusting colonies were irregularly rounded, filling the uneven depressions of the lower surface.

Phylum CŒLENTERATA.

Hydra viridissima Pallas (*H. viridis* L.), was found, but was evidently rare.

Hydra oligactis Pallas, (*H. fusca* L.), was somewhat better represented. Undoubtedly it was more common at times than these collections showed.

Phylum PLATYHELMINTHES.

Class TURBELLARIA.

Planaria gonocephala Duges, was the only species of the Tricladida found, and the few specimens were all from the lower surface of a large, flat, submerged stone, on the north shore, station 7.

The reason for the meagre lot of individuals and of species of flatworms, was the insufficient and unvaried food supply.

Dalyellia sp. was found merely by accident in examining some pond water microscopically. This and others of its group were very likely common in parts where algæ abounded.

Phylum NEMATHELMINTHES.

Class GORDIACEA.

Paragordius varius (Leidy). One adult found in algæ near the water's surface in the small pond was the only representative of the group taken in the entire survey. No special search was made for the parasitic larvæ.

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* For the numbers of specimens of all aquatic species found at the various stations, see the Table.

Phylum ANNELIDA.

Subclass OLIGOCHÆTA.

Order **Microdrili.**

Some worms of this group are among the most abundant animals in the entire pond. They could be compared favorably with midge larvæ, but since a good habitat which no doubt harbored myriads of some members of both groups, namely the bottom mud of the large pond, was hardly touched, no real estimate of relative numbers could be formed. The almost total absence in the large pond as compared with the small, of the mud-dwelling forms (Tubificidæ), is thus explained. Forms dwelling where algæ and other vegetation abounds, (Naididæ) would of course not be expected from most of the large pond.

Family *Naididæ.*

Chætogaster sp. This was among the scarcer forms of this family. The species could not be determined because of the immature condition of the specimens.

Slavina appendiculata (d'Udekem) (?). Worms of this genus, which were more numerous than the foregoing, could not be positively identified to species.

Nais sp. These tiny, transparent worms were the most abundant of the family. The largest number was found in the very shallow water of station 11, and chiefly in late spring. None were mature enough for specific determination.

Dero limosa Leidy. While it is very likely this species, only living material, (which was not available when Prof. Smith named them), would make determination positive in this genus. With a very few exceptions none of the specimens secured had the characteristic case built by Dero.

Family *Tubificidæ.*

Limnodrilus sp. This was one of the most abundant animal forms in the entire pond. Though not quite as many specimens were collected as of Nais, it must be remembered that only a very small part of its habitat was touched. They were quite evenly distributed throughout the collecting period. None were mature enough for accurate specific determination. Possibly all belonged to one species, which is at least very closely similar to *Limnodrilus hoffmeisteri* Claparede, found in Europe and also in this country.

Tubifex multisetosus (Smith). This genus, possibly about half as abundant in the pond as is Limnodrilus, was fully nine-tenths of this one species. Some specimens Prof. Smith found exceptionally mature and desirable for identification.

Tubifex tubifex (Müller) = (Tubifex rivulorum Lamarck). A few were identified as very likely of this species.

Aulodrilus pluriseta Piguet (?). Prof. Smith, who found two specimens of this among my Oligochæts, reports this as the first record of the occurrence in the United States of this genus. While the species is doubtful, it is at least similar to *A. pluriseta* Piguet, of Switzerland. The position of Aulodrilus is tentative; in fact its family relationships are problematical because its reproductive organs have not been studied. Smith reports that Piguet first put it among the Naididæ, and subsequently among the Tubificidæ, where it may remain for the present.

Apparently it is rare in this pond. Nothing more can be said than that the specimens were obtained with some of Tubifex, Dero, and Nais, station 11, June 5. Piquet (as Smith reported) describes these worms as living in the little tubes formed by particles of debris, held together by secretions, from the surface layer of the worm. When separated from their tubes they do not use the old ones again, but build new ones.

Order **Megadrili.**

Helodrilus caliginosus var. trapezoides (Duges). This, (Smith '17) the most abundant and most widely distributed American earthworm, abounding in the bottom lands of rivers, as well as less moist earth, was found in Mirror Lake in small number near the shoreline. These and a couple of other Lumbricids, (Helodrilus sp.) taken from the pond, undoubtedly were in the water by accident; hence they are not listed among the aquatic forms.

Class HIRUDINEA.

Leeches were well represented in Mirror Lake, considering the small size of the group.

Order **Rhynchobdellida.**

Family *Glossiphonidæ.*

Glossiphonia stagnalis (Linn.). This, (Moore '12) "abounds especially in warm, shallow waters of streams, pools and ponds; it is the common pond leech." It was the commonest leech in

Mirror Lake, abundant in fact, and more so than the numbers in the table would indicate. During most of the collecting period it could be found attached to dead leaves and a variety of other objects on the bottom of the small pond. Several females with egg masses attached ventrally, were taken in April and a considerable number of very young ones in May.

Glossiphonia fusca Castle, another small leech of similar habitat, was rare. Only one individual was taken during the entire survey.

Placobdella rugosa (Verrill). Only one rather small specimen of this "rough leech" was found. Undoubtedly it was rare here.

Order **Gnathobdellida.**

Family *Herpobdellidæ.*

Herpobdella punctata (Leidy) This large leech was common, but no complete idea of how numerous it was could be formed because of its bottom dwelling habit. Its swimming powers it never seemed to use. It could not have been entirely absent from the bottom of the large pond, even though the collections disclosed none there. Most of those secured would have been missed had it not been for the lowering of the water level in April, which stranded many on the newly exposed mud at station 1.

Phylum BRYOZOA.

Collections from Mirror Lake disclosed no specimens of the small but common group of fresh-water Bryozoa, though favorable places for attachment existed in great number, and were examined closely. A specimen of *Plumatella polymorpha* Kræpalin, on a Physa shell, was observed in an aquarium in the laboratory. The snail was believed to have come with other material from this pond; but this is not sufficient basis for inclusion in the pond list of species.

Phylum MOLLUSCA.

Class GASTROPODA.

Order **Pulmonata.**

The small pond was a favorable habitat for snails, principally because of the vegetation there. The large pond on the other hand was very unfavorable not only because of the lack

of vegetation suitable for pond species, but also because among the fishes which were present, were some which would feed on snails, (Baker '16).

Kinds of snails were rather few, but the group as a whole, because of good numbers among some species, was fairly prominent.

Dr. Sterki named quite a few specimens with a reservation but the writer includes definitely all specimens identified, in the species he referred them to. The numbers in the tables give very little idea of the total. Only a portion of all collected were identified.

Family *Lymnæidæ.*

Lymnæa obrussa Say. Only a few of the identified lot of Lymnæa were of this species, and probably it was rare. Specimens were practically full grown.

Lymnæa humilis Say. This was the common member of the genus; four-fifths of the identified Lymnæa were of this species. In comparison with the more numerous Physa, it could at best be called fairly common.

Lymnæa humilis rustica Lea (?) This was represented by a single specimen. Unquestionably it was rare.

Lymnæa humilis modicella was represented by two specimens; also rare.

Lymnæa parva Lea. (?) Only one specimen and doubtfully that, was found of this species.

Family *Physidæ.*

Physa gyrina Say. This well known species proved to be common, somewhat more so than Lymnæa humilis, judging from identified material. It was found at practically all stations in the small pond.

Physa heterostropha Say. This was the most abundant species of snail present. About three times as many were obtained as of P. gyrina, and they were secured at all stations in the small pond.

Physa integra Haldeman. Relatively few specimens were found and this species must be ranked as rather uncommon.

Vallonia pulchella Müller. A specimen of this purely terrestrial snail was accidentally in the water at station 11.

Class PELECYPODA.

Order **Eulamellibranchiata.**

Family *Unionidæ.*

Anodonta grandis Say. This large mussel was an inhabitant of the mud bottom of the large pond, but was not secured or even noticed until the draining of the pond, June, 1920, when two large pails full of specimens, 55 in number, were obtained. No doubt many others were present especially towards the center, so that the species can be easily considered common.

Family *Sphæriidæ.*

Musculium transversum (Say). This was the only small bivalve in the pond. At least, in the material identified, all specimens, though none were mature, could quite certainly be referred to this one species. It could be considered common in the small pond (where all specimens were taken) or even abundant for certain areas there, namely stations 12 and 3. None were secured elsewhere. Station 12 was the most favorable locality; the mud was not too deep and glutinous and had a surface layer of the so-called dust fine detritus. This was hardly apparent at station 3, but on the other hand was quite common too, along the east shore.

Phylum ARTHROPODA.

Class CRUSTACEA.

Subclass ENTOMOSTRACA.

All orders having fresh-water forms except Phyllopoda are present in Mirror Lake. Ostracoda are not included in the survey as stated in the introduction.

Suborder **Cladocera.**

Only two species were found in Mirror Lake. In spite of the unfavorable features of the pond, probably more could be expected, since Cladocera thrive in sheltered pools and ponds where food is abundant, live in the littoral region and (Birge '18) "among the weeds and feeding on algæ, and similar organisms." Practically all were taken from the small pond. Possibly other, smaller forms, commoner in open water, were missed.

Simocephalus serrulatus (Koch), said to be (Birge '18) the most abundant species of the genus was found only at station 3, principally in June. It was not common.

Simocephalus vetulus (O. F. Müller), said to be "not very abundant," but likely to be found anywhere where vegetation thrives, was found decidedly more common here and at more places in the small pond.

Order **Copepoda.**

This order, though with a smaller number of specimens collected, was somewhat better represented in species than Cladocera. Similarly there may have been limnetic forms entirely missed.

Cyclops bicuspidatus Claus, was the species most numerous in individuals and ranked as common. As Marsh noted it has its optimum in cold water, and all specimens were taken from Mirror Lake early in spring, none after April 16, when the temperature was 14° C. At the next collection, May 3, the temperature of the water was 16° C.

Cyclops albidus Jurine, was much less common; only a third as many as of *C. bicuspidatus*, were collected.

Cyclops serrulatus Fisher, was not uncommon and ranked midway in numbers of individuals between the other two species, as far as the collection could show.

Subclass MALACOSTRACA.

Order **Isopoda.**

Family *Asellidæ.*

Asellus was found quite common, and almost exclusively in the waters of the small pond together with the spring, station 13. It was found in masses of submerged algæ, on Lemna roots, debris and on the bottom.

Why nearly half of all Asellus material was secured from this spring, is not clear. There was less vegetation in it than in the pond, hence less food, and the bottom was no better. The temperature conditions might explain it. The temperature of the water in the spring from May 17, when the first collection was made there, to Oct. 4, was from 1° C. to 5° C. colder than in the pond. The most difference occurred in June; the least in October. At every collection in this period specimens were found in the spring and pond. On October 18, (date of the last collection) Asellus was found in the spring only, and the temperature of the water there was 2° C. higher than in the pond; but since the water in the pond was 7° C. colder than at the

preceding collection, the temperature in the spring, though lower than in summer, was more nearly like its preceding, prevailing temperature; that is there was less variation in the spring than in the pond. The difference in summer temperatures might seem negligible, but in winter the difference might have been of more consequence. No winter temperatures were taken but the spring water was never frozen and obviously of higher temperature than the shallow pond. Possibly the higher winter temperatures and the smaller variability in temperatures throughout the year explains the matter.

Asellus communis Say, was not uncommon. More than half were found in the waters of the spring.

Asellus intermedius Forbes, a smaller species, was far more common. Collections showed three times as many as of the more conspicuous *A. Communis*. A number of times (April 3, 16, May 7, and June 28) mature females were found which bore a brood sac filled with eggs on the ventral side of the body.

NON-AQUATIC ISOPODA.

Oniscus asellus Linn. (*Oniscidæ*). This common terrestrial sow bug, is not known to occur in water, though it inhabits moist earth. But one specimen was found in the water of the spring, station 13.

Armadillidium vulgare (Latreille). (*Armadillididæ*). Several specimens of this terrestrial pill bug, inactive, rolled up, but alive, were taken from the water, station 13. These, as well as the preceding, were doubtless there by accident.

Order **Amphipoda.**

Eucrangonyx gracilis (Smith). This was the one species of the order represented in the pond, and by only a small number of specimens. It was restricted to parts of the small pond, and none were taken later than April. Two out of six specimens carried a large egg mass on the ventral side of the thorax.

Order **Decapoda.**

Family *Potamobiidæ.*

Cambarus rusticus Girard. This, one of the commonest species in the region in a variety of situations (Osburn and Williamson, '98) was the only species which could be considered common, and that only on the basis that they were more numerous than the dipnet collecting revealed. Forms so well hidden in the mud as crayfishes, would be easily overlooked. Four out of five individuals sufficiently large for identification

were of this species. (A number of very young ones were too small and undeveloped for determination). The only male crayfish found was a half grown one of this species, from the mud of station 11. The others were females, two small ones and one quite large, all in soft shelled condition. All were from the small pond.

Cambarus bartoni robustus (Girard). Only one specimen of this species was found, a female of medium large size, taken at station 13. As this is a common "brook species," found among stones in rapidly flowing streams, (Pearse, '09) its presence in Mirror Lake was somewhat surprising, though it should be noted that having been found among stones near the north shore of the large pond, it was not as far from its habitat as it would have been in the small pond.

Class INSECTA.

The aquatic members of this class living in Mirror Lake were so numerous in kinds and individuals that they actually formed the dominant assemblage of animal inhabitants of the small pond, though they were reduced to a place of minor importance by the fishes in the large pond. Most orders, including aquatic forms, were represented here.

Order **Collembola.**

Springtails apparently were not abundant on the pond as a whole, but when found at some restricted area, as happened a few times, they were abundant in those places.

Sminthurides aquaticus (Bourlet) was a rare species; only one specimen was so identified out of all Collembola obtained.

Isotoma palustris (Müller) was a species of undoubtedly uncommon occurrence also; only three specimens were secured.

Podura aquatica Linn., was the most numerous by far of the Collembola here. It was abundant a number of occasions at some areas, and with better collecting methods decidedly more would have been obtained than the table shows. Possibly smaller and hence less conspicuous numbers were present in other parts of the pond also.

Order **Ephemerida.**

Larval stages only were taken, of the mayflies. No adults were noticed, not even a trace of their bodies after their ephem-

eral existence, or of the cast nymphal skins. Specific determination unfortunately was not possible. Very young specimens were not included in the genus identification and hence not counted in the table.

Hexagenia sp. Two specimens of a large species of burrowing nymph, were uncovered at the time of the draining of the lake, June, 1920. They would not have been recorded otherwise. They were partly in the mud, some distance from shore, near the west end of the large pond, nearest station 9. It was probably scarce in Mirror Lake.

Heptagenia sp. A few specimens of this were found clinging on the under surface of a large, submerged stone (station 7). Since this sort of habitat could easily be investigated and no more were disclosed, it must be deemed rare.

Cænis sp. This form was found at various points off shore on the bottom mud and silt, chiefly in the large pond. Though only a small number were secured probably it was not uncommon. The large pond may have harbored many, so as to have made it more common than Callibætis.

Callibætis sp. This form, (Needham '18), "an active climber among green vegetation," was found almost exclusively in the small pond, at a number of stations. It was common. An odd occurrence was a relatively large number in the shallow open water of station 17.

Order **Odonata.**

Adult dragon flies and damsel flies were common about the pond most of the season. Damsel flies especially were seen hovering over grasses on the margin. There many were collected several times during the summer. Dragon flies were not taken; those commonly present were recognized. A few strong fliers, seen only occasionally, are not listed, as very likely their early life history was not lived in the pond. Of the entire order, only such species of which nymphs were obtained from Mirror Lake are listed, except one or two, which unquestionably must have passed their early life history there. It is likely that not as comprehensive a collection of dragon fly nymphs was secured, because of their generally obscure haunts, as of the damsel fly nymphs.

Suborder **Zygoptera.***

Family *Agrionidæ.*

Argia violacea (Hagen). Nymphs of this species, unlike others of the Argias, and more like Lestes and Enallagma, could have been expected in good number in the small pond, for conditions there were ideal. "It oviposits" (Needham '03) "commonly in mats of algæ at the edge of the water or covering floating vegetation." Nymphs were rather few, all found in September, while the adults, not numerous either, were taken in the early half of summer.

Enallagma antennatum (Say). These nymphs were the most numerous in the pond; the species can certainly be listed as common. But as for adults only a very few were of this species. The discrepancy was largely due to the peculiar flight of this species close to the water line and directly through the shore vegetation (Needham '03), whence they were unwittingly overlooked while collecting more conspicuous fliers.

Enallagma exsulans (Hagen). This species was rare. Only one nymph and no adults were obtained.

Ischnura posita (Hagen). This species was less common than *E. antennatum.* Nymphs were most common early in the season. Adults were scarce at the time collections were made.

Ischnura verticalis (Say). This was a very common species and possibly it was more abundant than *E. antennatum* or at least equally common. Fewer nymphs but many more adults of this species were secured.

Suborder **Anisoptera.**†

Family *Libellulidæ.*

Libellula pulchella Drury. This was the commonest of the dragonflies. Adults were noticed often during the summer, and nymphs, though not numerous compared with the commonest damsel fly nymphs, were more numerous than all others of the suborder put together. With one exception all nymphs were from the small pond.

Libellula basalis Say was common about the pond but no nymphs whatever were secured.

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* Figures in table are of the nymphs collected that were identified. This excludes a very large number of small nymphs. Since adults were not collected at these definite stations, they are omitted from the numbers given in the table.

† Figures in the table are of the collected nymphs which were identified, except that Pachydiplax (represented by only one adult) is added.

Plathemis lydia Drury, was less common than *L. pulchella.* Adults were noticed quite often. Only a few nymphs were secured.

Sympetrum rubicundulum Say. Adults of this, and possibly of other closely similar species, were frequently seen. Reliance was unfortunately put solely on nymphal material. When identification was done only one nymph of this species and of the entire genus was found.

Pachydiplax longipennis Burmeister. A freshly emerged adult of this species was taken off shore at station 15, on April 22, 1920. This was very early in the season for it is reported for not earlier than May and June in Indiana. (Williamson '99).

Order **Hemiptera.**

Suborder **Heteroptera.**

Aquatic bugs, except surface forms, were restricted almost exclusively to the small pond. The group was an important one in the pond and some forms were abundant in numbers of individuals. The number of species was somewhat less than anticipated but very likely practically all species present at the time of the survey were obtained. Drake found also other species during his collecting (1914–1917). In connection with each family discussion, the additional species he found, are mentioned.

For classification and nomenclature, Van Duzee's check list ('16) and Catalogue ('17) have been followed, but in the arrangement of the families the more common and generally used one, such as used by Comstock ('16) was followed.

Family *Corixidœ.*

Water boatmen were almost exclusively found in the small pond and were commonest late in summer. The largest number of individuals came from the spring, station 13.

Arctocorixa alternata (Say). In the collected material as far as identified this was the least numerous of three species found; only a tenth of all Corixids were this. All were taken in station 17.

Arctocorixa scabra (Abbott M. S. sp.) Hungerford found this species much commoner in my material, about four times

as numerous as A. alternata. Most of them were from the spring, station 13.

Corixa verticalis Fieber. This was also a common species, possibly somewhat more so than the preceding. Very few were from the spring, most from the small pond, but also a few from the large pond.

Family *Notonectidæ.*

Notonecta variabilis Fieber. This was the only backswimmer found and only a single specimen was secured in the shallow, vegetationless pool, station 17. It was surprising to find it so rare and other members of the family entirely missing. Since they could not escape detection easily, it is probable that no other kinds were present at the time.

But Drake found a total of six species in a number of years collecting. Of the five, which I did not find, he wrote me that *Notonecta undulata* Say, was most common when he collected. *N. irrorota* Uhl., and *N. insulata* Kirby, both not uncommon, and *Plea striola* Fieber, and *Bueno margaritacea* Bueno rare.

Family *Nepidæ.*

Ranatra americana Montd. This was the only species of the family present. Just three specimens were found, in the slight vegetation and debris off shore at stations 14 and 15. Thorough combing around the large pond failed to disclose any elsewhere than at these favorable localities.

Family *Belostomatidæ.*

None of the largest members of this family were seen, but Drake reported that he found a few *Benacus griseus* Say.

Belostoma (Zaitha) fluminea Say, was the only representative of the family found. Only four specimens were found, so that this form, so generally common, was scarce here.

Family *Saldidæ.*

Micranthia humilis (Say). This was the only representative of the shore bugs found. It was rare, as only one specimen was found.

Drake reported the species fairly common when he collected, and also reported collecting a few *Saldula major* (Prov.) and *Saldula orbiculata* (Uhl).

Family *Mesoveliidæ*.

Mesovelia mulsanti White. This was abundant in Mirror Lake, and second to one of the small Gerrids (see below) the most abundant of all Heteroptera. It was commonest where algæ and duckweed were thick, and chiefly in the latter part of summer. Most of the specimens were taken in September.

Family *Hebridæ*.

This family is represented in local fauna by two species of Merragata described by Drake ('17).

Merragata brunnea Drake, was the only species found at Mirror Lake. Apparently it was rare; only one brachypterous specimen was taken, in among vegetation on the surface close to shore at station 15. None were secured from the small pond where it might have found favorable situations.

Family *Veliidæ*.

Microvelia borealis Bueno. This tiny water strider was common; possibly it should be listed as abundant. At least it was abundant at station 17, September 13, when most of them were found. The little pool was teeming with them, and many more could have been secured than were. While only a few were obtained at other stations, these were fairly well scattered, so that it is quite likely that there were times when they were numerous at more than the one locality.

Drake found ('16) *Microvelia americana* (Uhl.), which he said was more common than *M. borealis* Bueno. He also found a new species, *Microvelia hinei* Drake, recently described (Drake '20).

Family *Gerridæ*.

Gerris remiges Say. Somewhat surprising is the rarity of this water strider, which has been called (Bueno '11) "perhaps the most common of our species." Only one was found. Its large size would prevent its being overlooked.

Gerris marginatus Say. This was the most abundant species of the family next to *Trepobates pictus* and was undoubtedly a close third in general abundance among all Heteroptera. It was taken throughout the collecting period in both adult and nymphal stages. The vast majority were in the small pond and none on the open water of the large pond; those from the large were near shore where vegetation existed. This habitat

of the Gerrids offers evidently a striking contrast to that of *Trepobates*. Half of all specimens were secured at station 3. Larger water striders are often observed to be numerous in shady situations, but if shade was a determining factor here, it could not explain the very common prevalence of this same species at station 11, which had scarcely any shade.

Drake reported that in 1916 he captured also, as relatively scarce among *G. marginatus*, several specimens of *Gerris conformis* (Uhl.), more of *G. buenoi* Kirk., and a few of *G. canaliculatus* Say and of *G. rufoscutellatus* Latreille.

Tenagogonus hesione Kirk. This water strider, first reported for this region by Osborn and Drake ('15) and said by them to be common in the apterous but rare in the macropterous form, was represented in my collection by one macropterous specimen secured at station 11.

Trepobates pictus H. S. This little water strider was abundant and took first rank among Hemiptera, in numbers of individuals. Nymphs of all stages and adults of the apterous form were taken together. The gregarious habit was very noticeable. Practically none were present on the small pond. With these few and those at station 9 excepted, all were present on absolutely open surfaces of the large pond, though chiefly near shore. This distribution was contrary to that of *G. marginatus*, already noted. It was first obtained the middle of June, but remained common a number of weeks after collections were terminated in October.

A single macropterous specimen was included in the collection. This Drake informed me, is rarely seen. The folded wings extended beyond the abdomen about half the length of the body, but on one side wings were absent, probably having been torn off before coition.

NON-AQUATIC HETEROPTERA.

Halticus citri Ashm.* (*Miridæ*). One specimen of this terrestrial bug was found at station 3, an accidental inhabitant of the water.

Suborder **Homoptera.**

Family *Fulgoridæ.*

Pissonotus brunneus Van. D.† This terrestrial Delphacid was merely accidentally present in the water.

* Identified by Prof. Herbert Osborn.
† Identified by Prof. Herbert Osborn.

Family *Aphididæ.*

A few species of plant lice, living on aquatic plants may be considered aquatic, in at least as reasonable a sense as the Saldidæ or Collembola are so considered.

Rhopalosiphum nymphææ (Linn.) (?) Many aphids of this genus were found on the duckweed of the small pond, and some at station 5. Most because of immaturity could not be identified to species.

Macrosiphum coreopsidis (Thomas). A smaller number of these aphids were obtained. A few adults made specific identification possible. The species lives on Bidens, and some specimens were actually taken from emergent vegetation near shore. But the species is not reported from any real aquatic plants and must be excluded from an aquatic list.

Order **Thysanoptera.**

Phlœothrips nigra Osb. A very few were taken while collecting on the surface at station 11. But they were only accidentally there and are entirely land forms.

Order **Neuroptera.**

Family *Sialidæ.*

Sialis infumata Newman, was the only representative of the entire order and only a single larva was found in the mud at station 3. Probably some others were present, but it must be listed as rare.

Order **Trichoptera.**

Caddis worms were unusually rare as far as my survey demonstrated. The areas having a deep mud bottom, did not offer a favorable environment, but along shore in the large pond, principally in the stony areas, there would seem to have been a very favorable habitat for certain kinds of caddis larvæ.

Phryganea sp. One larva of this genus, taken somehow without the large characteristic cylindrical case, was found at station 3.

Order **Coleoptera.**

A comparatively large number of beetle species was obtained from Mirror Lake. Some of the species were represented by a considerable number of specimens. Large sized beetles, (except one *Hydrophilus triangularis*) were conspicuously absent.

Many beetle larvæ were obtained, but since the kinds were not recognized in collecting, and the species of a family are

closely similar in a general way, no specific habits or other observations were noted. A separate larval list was hoped for, but the larvæ, given to Dr. Mosher, could not be identified to species or even to genus, but merely to family, with, however, some segregation into presumable generic groups that may assist in future work on beetle larvæ. Figures in the table are of adult beetles entirely.

Family *Carabidæ.*

Elaphrus ruscarius Say, "probably the commonest species along margins of streams, ponds and lakes," (Blatchley '10), was found running on the moist, muddy shore close to the water's edge at station 2, but only a few specimens were seen, all in April. Because of their habitat, members of the genus Elaphrus are properly considered in an aquatic survey, possibly as much so as are the shore bugs, Saldidæ.

Family *Haliplidæ.*

Peltodytes 12-punctatus Say, a rather conspicuous beetle found in the shallow water among algal vegetation, in the small pond, was fairly common.

Peltodytes edentulus Lec., a beetle at first not differentiated from the preceding, was somewhat more numerous than that species.

The characteristic spiny larvæ of this genus were also found not uncommon in the same situations as the adult.

Family *Dytiscidæ.*

No large predaceous diving beetles were present, though there were reports of the one time presence of some form like Dytiscus. Their absence is explicable on examination of various features of the pond.

That depth of water of a pond is related to the presence of a particular kind, or rather particular sized beetle, was found (Needham and Williamson '07) to hold in a pond worked on at Lake Forest, Ill. Dytiscus prevalent in deepest water, then Acilius and then Coptotomus in shallower water, were lacking in Mirror Lake, which was not deep enough; but Laccophilus (the next in their succession, and inhabitating water about a foot in depth) was common in the small pond, where that depth of water prevailed over a large part. Hydroporus they found in still shallower water and Bidesses clung to the very shoreline.

The same distribution for these genera, generally speaking, was evident here.

In the small pond the obstruction of the duckweed covering to convenient surface respiration may have been a factor in the absence of large Dytiscids. But probably more important was the lack of all larger, emergent vegetation, the submerged parts of which are the only places favorable to Dytiscus for egg deposition, (Miall '12).

In the large pond there was the same lack of emergent vegetation. Absence of practically all vegetation was a factor too, for most beetles naturally thrive best in a certain amount of seclusion afforded by vegetation.

Very muddy pond bottoms are very poor habitat for Dytiscidæ (Sherman '13). He says, in fact: "These beetles prefer for their home bodies of comparatively clear water . . . . where the bottom is at least moderately clear and sandy." This would be optimum for many no doubt, but a small amount of mud would not be a deterrent if other conditions were fairly favorable. But in Mirror Lake the mud bottom is sufficiently deep and widespread to act as an inhibiting factor.

In view of these conditions the collection of Dytiscidæ present in the pond was all that could be expected.

Laccophilus maculosus Say. This was one of the common beetles in the pond, though not nearly as abundant as *Tropisternus glaber*. It was about equally numerous in all parts of the small pond and in the spring (station 13).

Laccophilus fasciatus Aube., was not uncommon, but not more than a third as many specimens were taken as of *L. maculosus*. Most specimens were from the shallow pool, station 17.

Desmopachria latissima,* (?). One specimen was obtained at station 11. It should be noted that the species has not been recorded from this region.

Bidessus affinis Say. This was the one species of the genus, which was even fairly common, considering that probably a relatively smaller number were secured and listed in the table, than of larger beetles. While all specimens were noticed practically on the shoreline, more were found at station 3 than at the shallower station 11.

* Identified as probably this species by Mr. C. W. Leng.

Bidessus lacustris Say. One specimen was taken.

Hydroporus modestus Aube. This fairly common beetle was about as numerous as *L. maculosus*. Practically all were from station 3.

Hydroporus concinnus Lec., was evidently rare as only one specimen was found.

Hydroporus pulcher Lec., was likewise rare with only one specimen found.

Hydroporus dichrous Melsh. probably must also be considered rare, as only two specimens were found.

Copelatus glyphicus Say.* This beetle of which only two specimens were found, was in the same general situation as *Hydroporus*. One of the specimens is piceous and the other slightly reddish.

Family *Gyrinidæ*.

This family was conspicuous by its absence. The writer can say with assurance that none were present during the period collections were made, though there were reports that whirligig beetles were present a few years before. The Lemna covered small pond would be very unfavorable for their gyrations, though the large pond presented no such difficulties. Possibly the absence of favorable aquatic plants for egg deposition was an important factor. Fishes, if they had any effect, would have relatively less upon these than upon other beetles.

Family *Hydrophilidæ*.

The beetles comprising this family were about equal in number of species to the Dytiscidæ, but more numerous in individuals, due chiefly to the abundance of a few common kinds. A considerable number of larvæ were obtained.

Helophorus lineatus Say. This species was found quite common but only at stations 3 and 11. They were usually noticed crawling on submerged vegetation.

Hydrochus inæqualis Lec. This beetle, found in about the same situation as the preceding, must be rated as rare.

Ochthebius nitidus Lec. (?)† Of this beetle also only one specimen was found, so that it must be rated as rare. It was found in vegetation at the very edge of the pond at station 3.

* Identified by C. W. Leng and H. C. Fall.
† Identified as probably this by Mr. C. W. Leng.

Hydrophilus triangularis Say. Of this species, the largest secured in the survey, only one specimen was found, in the debris off shore at station 15. Hence this, too, must be considered rare here.

Tropisternus nimbatus Say. This was fairly numerous but decidedly less so than *T. glaber*. It was well distributed in the small pond.

Tropisternus glaber Herbst. This was found much more common than its congener just mentioned, and was the most abundant beetle in Mirror Lake. It compared favorably in numbers with the commonest kinds of water striders, except *Trepobates pictus*. As is the case with other really abundant forms, relatively more could have been secured and counted, than the table indicates. They could not be as completely collected nor would be quite as assiduously kept as rare forms.

It was evidently present throughout the small pond and a few were also found in the large. Like *T. nimbatus* it was also found in the pool, station 17. But one place in the small pond, station 12, it was much more abundant than anywhere else. There the mud was not so deep and soft as on most of the bottom, and it had a thin layer of loose, fluffy, brown material, probably the so-called dust-fine detritus, which offered no impediment to the scrambling, swimming combination sort of movement across the bottom which these beetles indulged in.

Philhydrus nebulosus Say. This beetle was found in situations frequented also by *Helophorus*. Like many other beetles it was restricted to the small pond. It was common, and found principally near the north and northeast shore.

Philhydrus ochraceus Melsh. Of this related species only one specimen was found, and it undoubtedly was rare.

Cymbiodyta fimbriata Melsh. This beetle also frequented situations in the small pond like those mentioned above. It was fairly common.

Creniphilus subcupreus Say. This tiny beetle was taken in situations identical with the preceding form. It was very common. The greatest number was obtained from submerged vegetation near shore at station 3.

Family *Parnidæ*.

Dryops lithophilus Germar. This was the one beetle of this family found here. It has been found at Lake Mendota

"on the moist places of the shore" (Muttkowski, '18) and "it may occasionally descend into the water," the assumption evidently being that this form normally lives out of the water as an adult. The single beetle obtained in the present survey was submerged in several inches of water, clinging to the rough bottom of a large, flat stone at station 7. Search failed to disclose any more elsewhere along this pond, or anything which could have been its larval form.

Family *Dascyllidæ.*

Scirtes tibialis Guer. The larva of this beetle, which feeds on duckweed (Kraatz '18) should evidently have found the small pond an ideal habitat. The reason for their scarcity was not clear. They were so few and so scattered that it must be rated as rare.

NON-AQUATIC FAMILIES.

There were furthermore secured, whether on the surface or partly submerged, a number of other beetles of purely terrestrial kinds. They are mentioned here in order to complete the list of species collected, but are not considered among the aquatic forms in the table.

Olibrus consimilis March. (*Phalacridæ*). One adult was taken from on the water surface or overhanging grasses. The larva may have fed on Bidens.

Melanophthalma distinguenda Com.* (?) (*Lathridiidæ*). This specimen was taken close on the shoreline in vegetable debris at station 3.

Family *Chrysomelidæ.*

None of the aquatic members of this family were found; but several terrestrial beetles were there by accident.

Longitarsus testaceus Melch. One of these beetles was taken from aquatic plants near shore.

Chætocnema ectypa Horn† (?). One of these beetles was found in the same situation.

Chalepus dorsalis Thumb. One of these beetles was also found in a similar situation.

Suborder **Rhyncophora.**

Tanysphyrus lemnæ Fab.‡ This was the only aquatic species of snout beetle found here. Only three specimens were secured, from Lemna, but as they would be easily overlooked, they may have been fairly numerous at times.

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* Identified by Mr. H. C. Fall.
† Identified by Mr. C. W. Leng.
‡ Identified by Mr. C. W. Leng.

Hypera punctatus Fab. One specimen of this terrestrial snout beetle was accidentally found here.

Phytonomus nigrirostris Fab. Two specimens of this clover pest were also found here, probably having been blown in during a migration over the pond.

Order **Diptera.**

The number of forms of aquatic Diptera found in Mirror Lake, among families other than Chironomidæ, may seem rather small. As far as this is an actual incompleteness in the list, it is due to practical difficulties that existed. No adults were captured or even noticed, so that, unlike for most other orders of insects, no adults were available for identification, except for a very few which happened to breed out in the laboratory.

Family *Tipulidæ.*

Only one larva belonging to this family was found, (at station 3). It was immature and could not be identified even to genus.

Family *Culicidæ.*

Mosquitoes were not common. Probably the situation was not especially favorable for them. Certainly in the large pond, the fishes must have almost prevented the existence of the wrigglers, but in spite of that a few specimens were found along shore at stations 6, 7 and 9. Dr. Dyar suggested that few species were represented because all were collected late in summer. However, since collecting was done similarly from spring to fall, any other species that might have been present must have been very rare to escape detection completely.

Anopheles was the kind which comprised the largest number of individuals, almost two-thirds of all mosquito material collected. As only larvæ, and a few pupæ were available, the species could not be dètermined with assurance, though Dr. Dyar wrote that probably it was a mixture of both *Anopheles punctipennis* Say and *Anopheles quadrimaculatus* Say.

Anopheles punctipennis Say*. One adult mosquito of this species was secured just as it had freshly emerged at station 11.

Uranotænia sapphirina O. S. This species was next in individuals. About half as many larvæ were found as of *Anopheles.* The species is not a troublesome one, but Dr. Dyar said he was attacked by one once.

* Identified by Prof. J. S. Hine.

Culex territans Walk. This remaining species of mosquito found was rather scarce. Only a fifth as many larvæ were obtained as for the preceding species. Dr. Dyar wrote me that "it is wholly innocuous, confining its attention to frogs."

Family *Chironomidæ.*

The midges constitute a very important family which was represented by a very considerable number of kinds in Mirror Lake. It must be noted though, that the number of specimens secured large as it is, very likely gives relatively a very inadequate idea of the total midge fauna (as was true likewise of the small Annelid worms) because so much of the mud bottom of the large pond was not at all investigated. As the collections stand the vast majority of the larvæ were secured from the small pond. Undoubtedly midge larvæ formed an important article of food of some Mirror Lake fishes.

A number of bright red larvæ, the well known bloodworms were found in very shallow water, a few in fact in the clear, shallow pool, station 17, in hardly more than an inch of water and not buried in the mud. This bears out the fact, now generally well known (Malloch '15), and treated of especially in work at Lake Mendota (Muttkowski '18) that bloodworms are by no means exclusively bottom dwelling forms, as was so long held.

Adult midges were not seen in the field and unfortunately none reared in the laboratory, though several accidentally emerged from material in an acquarium jar. Pupæ were scarce as compared with larvæ.

Sub-family *Ceratopogoninæ.*

Palpomyia longipennis Lœw. This species was uncommon, probably it should be called scarce. All specimens found were taken in June, at station 3, and all were in the pupal stage.

Palpomyia sp. Other specimens of this genus, all in the larval stage, equal in number to specimens of *P. longipennis*, were found, chiefly at station 11, but were not identifiable to species. Whether they represent one or more than one species cannot be said.

Johannseniella sp. This form was rare beyond any question. Dr. Malloch found but a single larva in all the midge material identified.

Bezzia sp. This form, whether representing one species or more, was scarce, no more numerous than *Palpomyia*. Most specimens were in the pupal stage.

Sub-family *Tanypinæ*.

Tanypus pilosellus Lœw. This species was rare, as only three specimens, (two larvæ and one pupa) were found.

Tanypus monilis Linn. This species was somewhat more numerous than the preceding, but still scarce.

Tanypus dyari Coquillet. This species was common in various parts of the small pond, and was the only one common in the waters of the spring, station 13. Unlike most of its type, and more like many of the genus *Chironomus* it is a bloodworm. Those which lived in the spring, as well as two larvæ found at station 17, furnish good evidence that bloodworms may inhabit well aerated waters. A small number were in the pupal stage.

Tanypus sp. A number of specimens of larvæ of this genus, but of other species unidentifiable specifically, were found in about the same localities as *T. dyari*.

Tanypus sp. B. This species, tentatively so designated by Malloch ('15), was scarce, that is represented by a few specimens.

Sub-family *Chironominæ*.

Chironomus lobiferus Say. This species was common at station 12, but nowhere else. The larvæ are bloodworms. A few of the specimens were pupæ.

Chironomus viridicollis Van der Wulp. This was a common species, particularly in some parts of the small pond. It is one of the common bloodworms. Two were found in the shallow station 17. There was one pupa among the identified specimens.

Chironomus modestus Say. This was a rare species as only two specimens were found, both pupæ.

Chironomus sp. An extremely large number of other specimens of this great genus was found. None of these could be identified to species; unquestionably they represent at least several species as can be logically deduced from examination of figures in the table. It is unfortunate that an extremely abundant or several abundant or common species can not be listed.

Tanytarsus sp. This species was one of the abundant ones, particularly (as far as collections show) in some parts of the small pond. A small number were pupæ, but the vast majority

larvæ. Many were found in the tiny brown cases which *Tanytarsus* builds. Some of these were attached to dead leaves on the bottom, but more of them to stones, particularly those from parts of the large pond. From even the very incomplete records of distribution there, it would seem that unquestionably this was a very abundant species in the large pond.

Cricotopus trifasciatus Panzer. This species was fairly common at best and seemed rather evenly distributed.

Orthocladius sp. This kind, also not identifiable to species, was common, in fact at station 12 it was abundant.

Family *Stratiomyidæ.*

Stratiomyia sp. (?). Only one larva of a soldier fly was found, and that in the vegetation near the surface at station 13. The rarity is surprising. It was far from full grown and could not be fully identified but probably belongs to this genus.

Family *Tabanidæ.*

Chrysops sp. (?) One small, white larva not full grown, belonging to this genus evidently, was found at station 13.

Tabanid sp. Two other very small white larvæ not definitely identifiable to genus, were the only other members of this family found.

A Tabanid egg, mass was found about four inches above the water's surface on an upright emergent broad blade of grass, a foot from shore, in the vicinity of station 8.

Family *Sciomyzidæ.*

Tetanocera plumosa Lœw. This species of fly was of rare occurrence. Two adults bred out in the laboratory October 1, from their short, thick, cylindrical pupal cases which had been collected at station 3, September 20.

Tetanocera umbrarum Linn. This related species, also rare, was represented by only one specimen bred out June 13, from a pupa found at station 3, June 5.

Family *Ephydridæ.*

The minute flies of this family represented here were all bred out in the laboratory. No larvæ were observed or found. They were in the pupal stage when collected.

Notiphila sp. One specimen only of this genus was secured. Hence it was rare. This accidentally bred out from a lot of

material (duckweed, etc.) kept in a battery jar. The pupa was not noticed, and its presence unknown until the emergence.

Hydrellia ischiaca Lœw. This rare species, represented by one adult, bred out under conditions like the preceding.

Parydra breviceps Lœw. This rare species was also represented by one fly bred out as were the preceding.

Philygria opposita Lœw. This kind can be rated as fairly common. While larvæ were not seen, pupæ were numerous and easily found. They were small, oval, of a brownish color, situated in the parenchyma of Lemna leaves, never more than one to a leaf, and centered quite well in the thickest part. The largest number were obtained September 8, and most of those obtained then bred out as flies September 25.

Class ARACHNIDA.

Order **Acarina.**

Water mites were surprisingly rare in Mirror Lake during the period of my collecting. Forms swimming about as conspicuously as they could hardly be overlooked. Conditions in the pond would have seemed favorable enough for mites. Only two individuals were found, both in the small pond, but unfortunately neither specimens nor record of the names have been received from the specialist to whom they were sent for determination.

Order **Araneida.**

Spiders taken in this survey were either on the water's surface, or on vegetation above the surface, or directly on the shore line. At no time did I see a spider dip beneath the surface, though one species included here does that. It is realized that the others, though adapted to moist situations, are not properly regarded as members of an aquatic list.

Dolomedes sexpunctatus Hentz. This can be called a true aquatic spider, for in addition to frequenting moist places and water surfaces, it is known to dive and lurk under floating leaves. It was not common, but specimens were secured from a number of stations.

Glenognatha (Mysmena) bulbifera (Banks). One young specimen of this non-aquatic species was found on aquatic vegetation.

Tetragnatha sp. Members of this genus are not aquatic or even moisture loving (Comstock '12). The few specimens of this genus were found on the water or plants off shore merely by accident.

Lycosa sp. One immature specimen of this genus was found. Although there is one species aquatic in the manner of *D. sexpunctatus* it is not found in this region, and the one taken was undoubtedly a terrestrial one.

Pardosa nigropalpus Emerton. This, an inhabitant of moist places, was found on vegetation above water at a number of stations, but is not to be regarded as aquatic.

Phylum CHORDATA.

Subphylum VERTEBRATA.

It is not known what fishes were in the creek that flowed through the ravine in the early days, nor just what kinds and when fishes were introduced into Mirror Lake, but that some were introduced before the draining of 1895 and several times subsequently is certain. In 1898 (Osburn '99) a spring freshet carried many down to the Olentangy. These points are worthy of note because the fishes, at least to a relatively far greater extent than any other forms, owe their existence in the pond, to artificial introduction. They established themselves firmly, and so altered conditions in the large pond, as to be the dominant organisms there.

In the small pond very few fishes were found. Before connection of the large with it (April, 1919) they were rare there as far as could be ascertained without seining. The union gave opportunity for migration. Though none were observed moving from the large pond, through the narrow channel into the small, some fishes were seen in the latter in the fall of 1919, and decidedly more in the spring of 1920.*

No study of fish food was undertaken. Hence it is only on general principles, but substantiated by deductions from comparisons between the two ponds, that it can be said that the absence of many forms of life in the large pond, could be attributed to the fishes. The large pond was probably overinhabited as far as fishes are concerned. The supply of natural food was added to at times by throwing in broken bread, usually in the vicinity of station 4. The goldfish took to this food more readily than others.

All fishes were collected in two seinings (September 27 and October 4), by Mr. Wickliff and the writer.

* The interesting study of the effects in course of time, of increasing numbers of fishes in the small pond, on the fauna there, can never be made, since the small pond was done away with, June, 1920.

Since none of the fishes could be ascribed to any particular stations, they are entirely omitted from the table.

Family *Siluridæ.*

Ameiurus nebulosus (Le Sueur). The common bull-head or brown bull-head was rare in Mirror Lake. Only one specimen was taken, but it must be noted that since they are bottom dwelling forms, and since the seining along the bottom was very much interfered with by projecting stumps, branches, and stones, others may have escaped.

Ameiurus melas (Rafinesque). The black bull-head was possibly a little less scarce, if the fact that three specimens were taken in the seine as compared with one of the above, is basis for this judgment.

Family *Catostomidæ.*

Catostomus commersonii (Lacepede). The common sucker was also apparently rare. One specimen was secured.

Family *Cyprinidæ.*

Cyprinis carpio Linn. This introduced form, the well known carp was not secured in the seine, but is here included on the basis of positive declaration that it has been taken from the pond, on the fact that we caught glimpses of what unmistakably were carp, and also on the fact that a peculiar specimen was caught which proved to be a true hybrid between a carp and a goldfish.

Carassius auratus (Linn). The goldfish is a common, conspicuous form in the pond, but it certainly did not rank better than third in abundance, although it was the fish most readily seen.

Pimephales notatus (Rafinesque). The blunt-nosed minnow was common but probably somewhat less so than the goldfish.

Abramis crysoleucas (Mitchill). The golden shiner was the most abundant of all fishes in Mirror Lake. Seining disclosed great numbers, quite in excess of the second most numerous species.

Family *Centrarchidæ.*

Apomotis cyanellus (Rafinesque). The green sunfish was also common, in fact very likely the second in abundance of all the fishes.

Class AMPHIBIA.*

Family *Bufonidæ.*

Bufo americanus Le Conte. Toads were scarce here in the breeding season, the only time that adult toads take to water. Some were noticed in spring 1919, but none whatever caught until May, 1920, when a few were observed and one caught, near shore, in the large northwest arm of the large pond. Two others, subsequently captured, were in similar locations. Toads were reported to have been very common about the pond years ago.

Family *Ranidæ.*

Frogs were relatively few in Mirror Lake during the time of this survey, though they also had been much commoner at one time. Very few places along the shoreline offered suitable places of seclusion such as they frequent when out of water.

Rana pipiens Shreber. The common leopard frog could probably not be rated as common here. Numbers were observed in the spring of 1919, but none caught. In fact not until May, 1920, when some more were seen, were two caught and identified. They were taken along the edge of the small pond near station 3, and during a few days, half a dozen more were observed along that pond edge jumping from the grass into the water. One was also observed along the south shore of the large pond and one in the northwest arm of that pond near the bridge.

Rana clamitans Latreille. A large specimen of a male green frog was caught May 15, 1920, while it was squatting at the water's edge on a depressed grassy area, along the southeast shore of the large pond. This species was no doubt scarce.

Class REPTILIA.

Reptiles were scarce in Mirror Lake. Possibly some other form than the two noticed, was present for somewhat as in the case of Amphibia, their habits of seclusion would make them inconspicuous.

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* Amphibia, since not closely connected with definite stations, are omitted from the Table.

Order **Chelonia.**

Family *Testudinidæ.*

Chrysemys marginata (Agassiz). The western painted terrapin was the only member of the order found here. A small specimen was taken at station 3 in May. One somewhat larger was seen exposed for a short time at the surface and then submerged out of sight beneath the duckweed. A still smaller one was taken in the northwest part of the large pond, north of the bridge, May, 1920.

Order **Ophidia.**

Family *Colubridæ.*

Natrix (Tropidonotus) fasciata sipedon (Linn). The common water snake was found to be rare here. One young specimen (7 inches long) was caught, and was the only one noticed. It was swimming close to shore near station 3, May, 1920.

Class MAMMALIA.

Order **Rodentia.**

Fiber zibethicus (Linn). The muskrat was the only one of the true aquatic mammals present here, and it was rare. There would appear to have been a dearth of appropriate situations and materials for home building, although the shallowness of the water and the possibility of constructing burrows under overhanging banks which existed at some places probably were favorable conditions. Whether there was only one or two, or a few more present could not be ascertained. One was seen to swim straight across a portion of the east end of the large pond, and then submerged. Efforts to locate it were futile. On another occasion, a pathway straight through duckweed on the small pond, showed that a muskrat had traversed there.

Mus norwegicus Erxleben. The large brown rat would also very likely have been an inhabitant of burrows underneath overhanging banks. It was reported (Stehle '20) as present, and the writer saw one take to the water and disappear under the banks east of station 6, but no trace of it could be subsequently found.

TABLE I.

NUMBERS OF SPECIMENS OF THE VARIOUS AQUATIC SPECIES SECURED AT THE VARIOUS STATIONS.

NAME OF SPECIES	STATION NUMBERS																Total
	SMALL POND							LARGE POND									
	1	11	17	13	2	12	3	4	14	15	5	6	7	16	8	9	10	
Spongilla fragilis (colony)														1				1
Hydra viridissima	2																	2
Hydra oligactis	7	3					1											11
Planaria gonocephala													3					3
Paragordius varius					1													1
Chaetogaster sp.	5	1																6
Slavina appendiculata (?)	10	5			1		4											20
Nais sp.	10	71				10	17									1		109
Dero limosa (?)		2				4	3											9
Limnodrilus sp.	1	54			6	33	1				1							96
Tubifex multisetosus	6	15		1	2	18	6											48
Tubifex tubifex (?)		8				2	1											11
Aulodrilus pluriseta (?)		2																2
Glossiphonia stagnalis	6	41			3	7	15	2			1							75
Glossiphonia fusca		1																1
Placobdella rugosa						1												1
Herpobdella punctata	18				11	1												30
Lymnaea obrussa	1						1											2
Lymnaea humilis & var.			6		1	2	3										1	13
Lymnaea parva (?)																		1
Physa gyrina	7	2		1	1	2	7									1		20
Physa heterostropha	16	5	2	2	4	11	29											69
Physa integra	2			1			3										3	9
Anodonta grandis															55			55
Musculium transversum					1	8	5											14
Simocephalus serrulatus							20								1			21
Simocephalus vetulus	50	3			4		10									1		68
Cyclops bicuspidatus	35																	35
Cyclops albidus	5	1					1											7
Cyclops serrulatus	12	10																22
Asellus communis	5			11	5		3											24
Asellus intermedius	8	5		25	2	3	16	1				1						61
Eucrangonyx gracilis	3						3											6
Cambarus rusticus		2					2											4
Cambarus bartoni robustus										1								1
Sminthurides aquaticus							1											1

TABLE I—(Continued).

Name of Species	Station Numbers																Total
	Small Pond							Large Pond									
	1	11	17	13	2	12	3	4	14	15	5	6	7.	16	8	9	10	
Isotoma palustris		1				1		1										3
Podura aquatica		3		5	1		3			2	6	14	14					51
Hexagenia sp.																2		2
Heptagenia sp.													1					1
Caenis sp.		1						4		1	1		1			3	1	12
Callibaetis sp.		8	12		1	8	11						1					41
Argia violacea							4											4
Enallagma antennatum	2	6	2	1		1	1					1			1			15
Enallagma exsulans														1				1
Ischnura posita	2		1		3	2		2	1				1					12
Ischnura verticalis	2	2			3	1	1			2	1							12
Libellula pulchella	1				4	2	4									1		12
Plathemis lydia				1		2												3
Sympetrum rubicundulum													1					1
Pachydiplax longipennis										1								1
Arctocorixa alternata			8															8
Arctocorixa scabra	9	4		13		2	3											31
Corixa verticalis		5	10	3			12			5				1		4		40
Notonecta variabilis			1															1
Ranatra americana									1	2								3
Belostoma fluminea		1					1		1	1								4
Micranthia humilis												1						1
Mesovelia mulsanti		15	1	1		14	11		6	5		4	1			4		62
Merragata brunnea										1								1
Microvelia borealis		3	12							1		1	1			1		19
Gerris remiges							1											1
Gerris marginatus		25		3	2	4	35			1	1				1	5		77
Tenagogonus hesione		1																1
Trepobates pictus		2					2	4	2	6	55	6	47	1	4	30		159
Rhopalosiphum nymphaeae (?)		25				8	1				1							36
Sialis infumata							1											1
Phryganea sp.							1											1
Elaphrus ruscarius					2													2
Peltodytes 12-punctatus		2	5	1			3									1		12
Peltodytes edentulus		5	5	1		2	3									2		18
Laccophilus maculosus	2	2	3	6		5	5			1								24
Laccophilus fasciatus		2	7			1												10
Desmopachria latissima		1																1

TABLE I—(Continued).

Name of Species	Station Numbers																Total
	Small Pond							Large Pond									
	1	11	17	13	2	12	3	4	14	15	5	6	7	16	8	9	10	
Bidessus affinis		1	1				7									2		11
Bidessus lacustris							1											1
Hydroporus concinnus																		1
Hydroporus pulcher						1												1
Hydroporus modestus				1		2	20											23
Hydroporus dichrous		1					3											4
Copelatus glyphicus							2											2
Helophorus lineatus		9				1	13					1						24
Hydrochus inaequalis							1											1
Ochthebius nitidus (?)							1											1
Hydrophilus triangularis										1								1
Tropisternus nimbatus		3	1			1	4			1								10
Tropisternus glaber	3	19	3	4		37	8			1					2			77
Philhydrus nebulosus	2	12				9	2											25
Philhydrus ochraceus		1																1
Cymbiodyta fimbriata		2				7	2											11
Creniphilus subcupreus		6				5	18											29
Dryops lithophilus													1					1
Scirtes tibialis (larva)							2	1							1			4
Tanysphyrus lemnae		2					1											3
Tipulid larva							1											1
Culex territans				2			2											4
Uranotaenia sapphirina		5	1	5		1	9											21
Anopheles punctipennis		1																1
Anopheles sp.		15	4	10			20	1				2	2		1	1		56
Palpomyia longipennis							10											10
Palpomyia sp.		10					2											12
Johannseniella sp.		1																1
Bezzia sp.		6					6								2			14
Tanypus pilosellus		1					2											3
Tanypus monilis	1	7			1		1											10
Tanypus dyari	1	12	2	15	2	4	11											47
Tanypus sp.	1	5				7	1											14
Tanypus sp. B.		3				5												8
Chironomus lobiferus		4				18	4											26
Chironomus viridicollis		30	2	5			16										1	54
Chironomus modestus							2											2
Chironomus sp.	5	81			5	95	74					5	4			33		302

TABLE I—(Continued).

Name of Species	Station Numbers																	Total
	Small Pond							Large Pond										
	1	11	17	13	2	12	3	4	14	15	5	6	7	16	8	9	10	
Tanytarsus sp.	1	16				8	33	3	5		7	8				14	5	100
Cricotopus trifasciatus	8	3				13	11									7	1	43
Orthocladius sp.	3	18				43	4				1					4		73
Stratiomyia (larva)				1														1
Chrysops sp. (larva)				1														1
Tabanid larva					1							1						2
Tetanocera plumosa							2											2
Tetanocera umbrarum							1											1
Notiphila sp.																1		1
Hydrellia ischiaca				1														1
Paraydra breviceps						1												1
Philygria opposita						4	3					14						21
Dolomedes sexpunctatus							1				1	1	2			1		6
Chrysemys marginatus						2										1		3
Natrix fasciata sipedon							1											1

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EXPLANATION OF PLATE II.

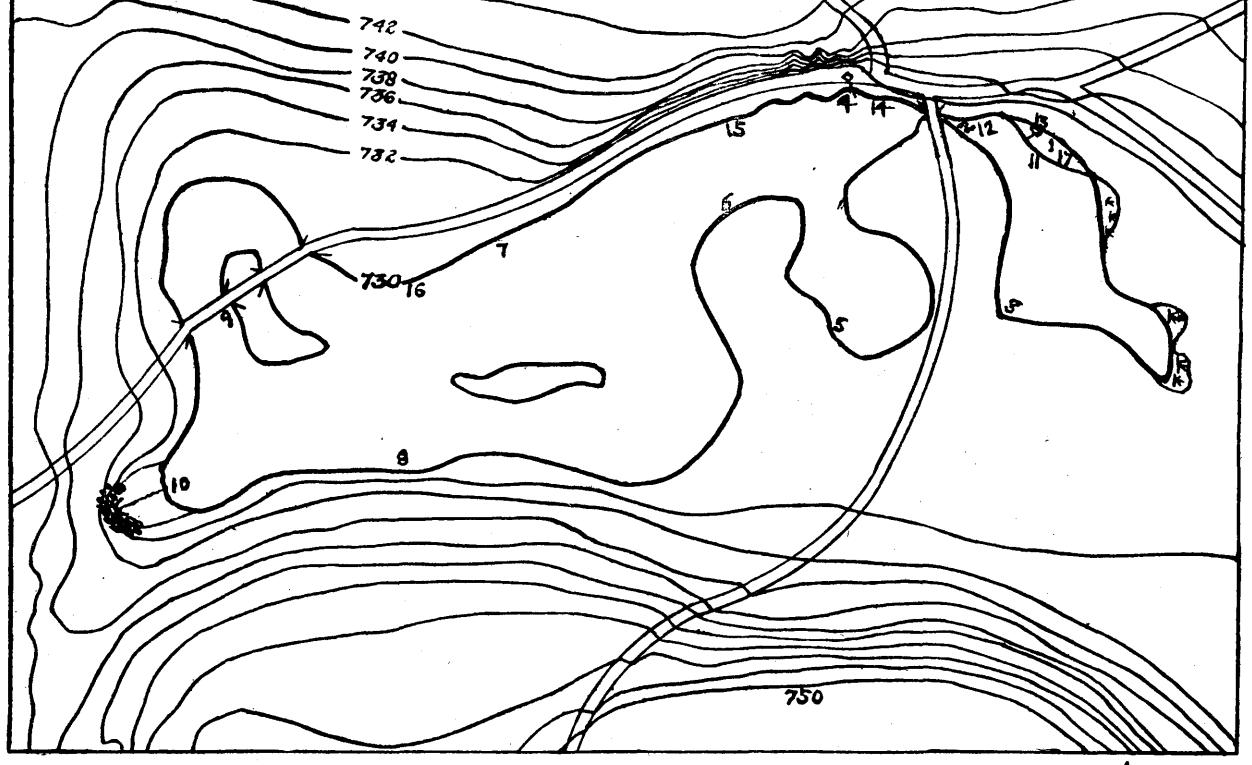
(Mirror Lake views before the alterations made June, 1920).

Fig. 1. The large pond; taken from the west end (near station 10) looking eastward; island in center; portion east of line crossing at about region of stations 6 and 15, not visible.

Fig. 2. The large pond; the east end, looking eastward from a point on north shore midway between stations 7 and 15; stations 4 and 14 at left; station 6 at right; connection with small pond under walk (white line) to left of center.

Fig. 3. The small pond; looking in northwest direction from southeast end; station 3, darker area directly across at left of center; station 12 upper right end of pond; duckweed (showing white) covering most of water. August, 1920.

Fig. 4. The small pond; looking across at east shore, north half; station 11 occupying most of foreground; station 13, the spring, open spot on shore to left of center. August, 1920.



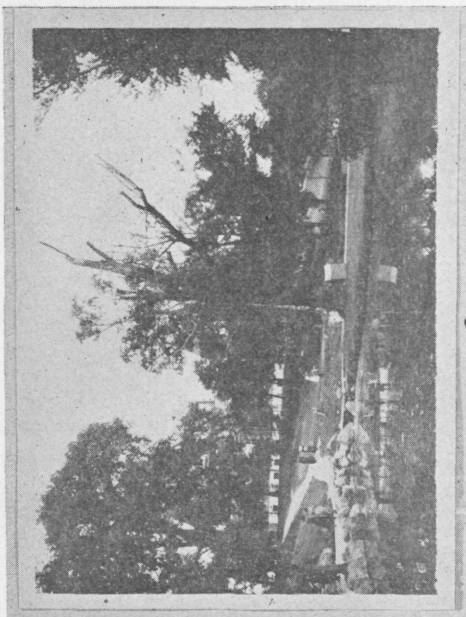
Legend

Contour
Water-line
Spring

Marsh
Walk

W — E

MIRROR LAKE



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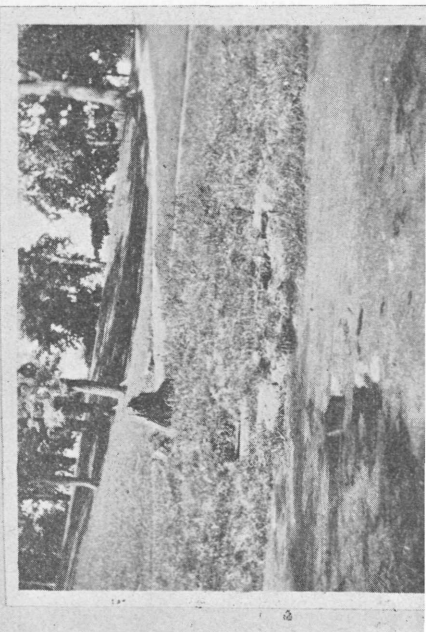

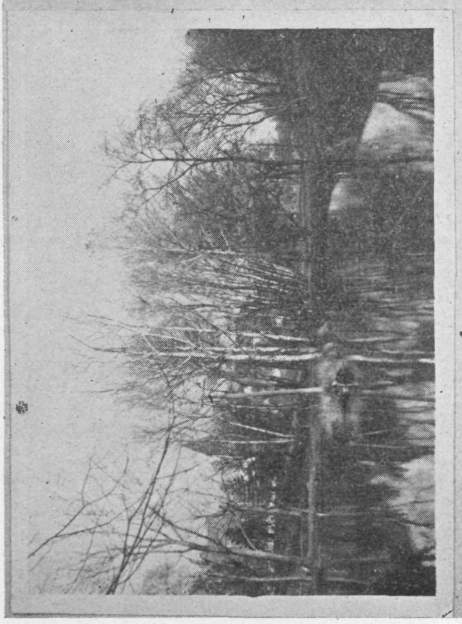

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